MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

EEM1016 – ENGINEERING MATHEMATICS I

(All Sections / All Groups)

30 MAY 2016

2.30 p.m. – 4.30 p.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS:

1. This exam paper consists of **4 pages** (including cover page) with **5** Questions only.
2. Attempt all the questions. All questions carry equal marks and the distribution of marks for each question is given.
2. Please write all your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.
3. Only NON-PROGRAMMABLE calculator is allowed.

Each question is 20%. Attempt all of the questions.

Question 1

(a) Evaluate the following limits:

(i) $\lim_{x\to 4}\dfrac{4-x}{\sqrt{x}-2}$ [2 marks]

(ii) $\lim_{x\to 0}\dfrac{6x-\sin 2x}{2x+3\sin 3x}$ [2 marks]

(b) (i) Let $f(x)=x^2\sin\left(\dfrac{1}{x}\right)$, where $x\neq 0$. Find $f'(x)$. [3 marks]

(ii) Determine $\dfrac{dy}{dx}$ if $e^{xy}+2y\ln x=\cos 3x$. [4 marks]

(c) Evaluate the following integral:

(i) $\int\dfrac{(x+1)^2}{x^{0.5}}dx$ [3 marks]

(ii) $\int x\sqrt{1-x^2}\,dx$ [6 marks]

Continued...

Question 2

A periodic function $f(x)$ is defined within the period $-\pi < x < \pi$ by

$$f(x) = \begin{cases} 5 & (-\pi < x < 0) \\ -5 & (0 < x < \pi) \end{cases}$$
$$f(x + 2\pi) = f(x)$$

(a) Sketch a graph of $f(x)$ for $-3\pi < x < 3\pi$. [3 marks]

(b) Is $f(x)$ an even or odd function or neither? Find its Fourier series expansion. [15 marks]

(c) To what value will the Fourier series converge by taking $x = \frac{\pi}{3}$? [2 marks]

Question 3

(a) Find the real values of x and y if $(2x + 3iy)(10 + 5i) = 5 + 3i$ [5 marks]

(b) Given $z = \frac{2}{1-i}$. Express in polar form. [5 marks]

(c) Let $A(1,1,-1), B(2,0,2)$ and $C(0,-2,1)$ be the three points on a plane.

(i) Find the vector product $\overrightarrow{AB} \times \overrightarrow{AC}$. [4 marks]

(ii) Find the equation of the plane that contains those points. [2 marks]

(d) Find the equation of a line (in parametric form) that passes through the point $(1,2,3)$ and is parallel to the vector $v = \langle 5,7,9 \rangle$. [4 marks]

Continued...

Question 4

(a) Determine whether each of the following series is convergent or divergent:

(i) $\sum_{n=0}^{\infty}(-1)^n \frac{3^n}{(n+1)!}$ [5 marks]

(ii) $\sum_{n=0}^{\infty} \frac{5^n}{(n+1)^2}$ [5 marks]

(b) Find the radius and interval of convergence for the following series:

$$\sum_{n=1}^{\infty} \frac{2^n x^n}{(-7)^n n}$$ [10 marks]

Question 5

(a) Use Lagrange multipliers to prove that the rectangle with maximum area that has a given perimeter P is a square. [6 marks]

(b) The length l, width w and height h of a box change with time. At a certain instant the dimensions are $l = 1\,m$ and $w = h = 2\,m$, and l and w are increasing at a rate of $2m/s$ while h is decreasing at a rate of $3m/s$. At what rate the surface area of the box is changing?

[9 marks]

(c) Show that the $\lim_{(x,y)\to(0,0)} \frac{xy}{x^2+y^2}$ does not exist. [5 marks]

End of paper.